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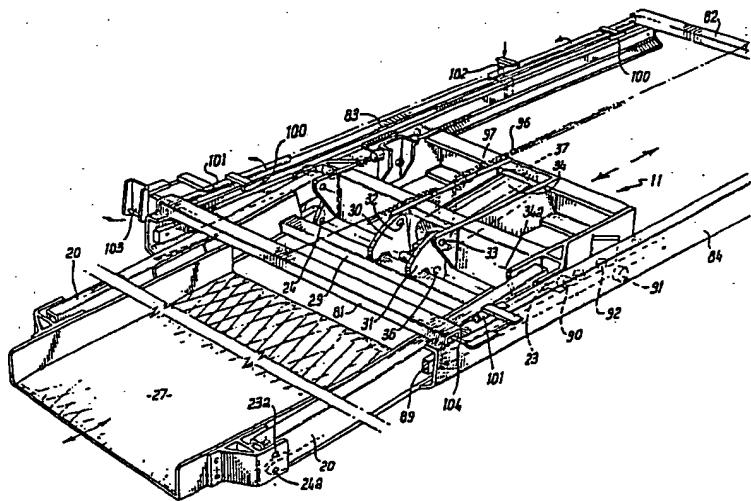
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**(54) Title: VEHICLES AND VEHICLE LIFTS**



**(57) Abstract**

A vehicle lift for stowing beneath the floor of a vehicle includes rails (83, 84) in which can move structure (11). A platform (27) is pivoted to the outer pivots (23a, 24a) of two parallelogram arrangements (20) whose inner pivots (23, 24) are with structure (11). A ram (34) is pivoted between the structure (11) and structure including plates (30, 31) pivoted at (32, 33) on axis (34) to the structure (11). The pivots (32, 33) are coaxial with pivots (23) and the ram is pivoted to plates (30, 31) at a location spaced from axis (34). The platform can be raised and lowered when the lift is not stowed. Arrangements are described in which the lift is stowed in an inclined position; in which the platform can form a step; in which the parallelograms are modified to alter the inclination of the platform.

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VEHICLES AND VEHICLE LIFTS

This invention relates to vehicles and vehicle lifts.

According to one aspect of the invention a vehicle lift comprises lift structure movable relative to a support between inner and outer positions, the lift structure comprising inner mounting structure and an outer platform, a parallelogram arrangement having an outer pivotal connection to the platform and an inner pivotal connection to the mounting structure, the inner pivotal connection comprising upper and lower pivots, and means for raising and lowering the parallelogram arrangement, the means being connected to the parallelogram spaced from the upper pivot.

There may be two laterally spaced parallelogram arrangements having coaxial upper pivots, the parallelogram arrangements being connected by intermediate structure pivoted to the mounting structure coaxial with the upper pivots, the means being pivoted to the intermediate structure.

The means may comprise a ram.

The support may comprise spaced rails curved at an outer region so that the platform changes its orientation to the rails as the lift structure is moved between inner and outer positions.

The platform may be adapted to form a step in the raised position.

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The parallelogram may be modified to change the inclination of the platform in the raised position.

The term platform is intended to include any load-supporting structure.

5 The invention also includes a vehicle lift comprising a platform movable between extended and retracted positions, the platform in the extended position being movable between lower and raised positions, the platform being adapted to form a step in a raised  
10 position.

The invention further includes a vehicle lift comprising a platform which can be raised and lowered by means comprising a parallelogram arrangement, in which the parallelogram is modified to change the inclination  
15 of the platform in a raised position.

From another aspect the invention provides a vehicle lift including structure movable on rails, the rails comprising an exposed elongate element spaced from a support and engageable by rollers of the structure.

20 The invention further provides a vehicle lift comprising mounting structure movable relative to a support between inner and outer positions, lifting structure comprising a platform and movable relative to the mounting structure between upper and lower positions  
25 independently of the position of the movable structure relative to the support between said positions.

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The invention includes a vehicle having a lift as above, in particular with the support below a floor of the vehicle.

The invention further provides a vehicle lift 5 mounted beneath a floor of a vehicle and having support structure and lift structure movable relative to the support structure in a direction inclined to the horizontal between withdrawn and extended positions, the lift structure including a platform movable up and down 10 in the extended position.

The invention may be performed in various ways and some specific embodiments with possible modifications will now be described by way of example with reference to the accompanying drawings, in which:

15 Fig. 1 is a side view of a vehicle with lift;  
Fig. 2 is a perspective view of part of a lift;  
Fig. 3 is a perspective view of another part of the lift;  
Fig. 4 is a section through part of Fig. 3;  
20 Fig. 5 is a plan view of the lift;  
Fig. 6 is a rear view of another arrangement;  
Fig. 7 is similar to Fig. 3;  
Fig. 8 shows operation of the lift;  
Fig. 9 shows a modified platform;  
25 Figs. 10A, 10B show a modified lift;  
Fig. 11 shows a drive system;  
Fig. 12 is an enlarged view of part of Fig. 10A;  
Fig. 13 shows operation of a lift;  
Fig. 14 shows a modification;  
30 Figs. 15, 16, 16A show a modification.  
Fig. 17 shows a vehicle with rear lift;  
Fig. 18 is a side view of a platform ramp;  
Fig. 19 is an end view of part of Fig. 18;  
Fig. 20 shows a platform;  
35 Fig. 21 is a side view of a bridge device; and  
Fig. 22 is an end view of Fig. 21.

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Referring to Figs. 1 to 5, a vehicle lift 10 comprises a mounting structure 11 comprising fabricated side members 12, 13 fixed to cross-members 14, 15 with bracing 16. Parallel plates 17, 18 are fixed to the 5 cross members parallel to members 12, 13.

A parallelogram arrangement 20 comprises two pairs of upper and lower side elements 21, 22 and 21a, 22a. The elements in each pair at one end are pivoted at 23, 24 between the sides of members 12, 13 with cut-out 25. 10 At their other ends the elements 21, 22 are pivoted at 23a, 24a to the front of a rear part 26 of a flat platform 27 having a front part 28 which is pivoted to the front of the part 26 so as to be movable between an open position (Fig. 3) and a closed position (A in Fig. 1). 15 The platform is shown open in full line in Fig. 1. The elements in each pair 21, 22 and 21a, 22a nest within each other at all times so that no gap exists between them as viewed sideways; this is a safety feature.

Towards their rear ends the upper elements 21, 21a 20 are connected by a cross-member 29 to which are fixed two arms 30, 31 respectively pivoted to plates 17, 18 at 32, 33 on a common transverse axis 34a which is in line with pivots 23. A hydraulic piston/cylinder ram 34 is located between plates 17, 18 and the piston 35 is 25 pivoted at 36 to cross member 29 and the cylinder pivoted at 37 to cross member 14. Pivot 36 is spaced from axis 34.

When the ram 34 is energized and deenergized the parallelogram arrangement 20 is pivoted up and down (see Fig. 1). In use, the platform remains horizontal.

30 The mounting structure 11 is movable between side rails or supports 40, 41 between an outer or operative position (Fig. 2) and an inner or inoperative position, shown dotted at B in Fig. 1. Any suitable means may be used but as shown the outer faces 42 of members 12, 13 35 are provided with two or more spaced bosses 43 having upper and lower plastics pieces 44, 45 in sliding engagement with plastics liners 46, 47 on the confronting faces of the upper and lower arms of the rails 40, 41.

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Brackets 48 (only one shown) are respectively fixed to the members 12, 13 and are secured to respective chains 49 extending round sprockets 50, 51 secured to the rails 40, 41. A motor 52 e.g. electric, can rotate 5 the sprockets 51 on a common axle to move the structure 11 in and out on the rails.

It will be understood that because the elements 21, 22 and 21a, 22a are inwards of rails 40, 41 the ram 34 can be operated to raise or lower the platform 10 at all positions of the structure in relation to the rails 40, 41.

The lift 10 is intended primarily for use by the disabled and handicapped, in particular with wheelchairs, and for mounting beneath the floor 60 of a 15 vehicle. Fig. 1 illustrated mounting beneath the rear of a vehicle having a rear door, and rear bumper 61.

If there is sufficient room beneath the vehicle the lift can be mounted with rails 40, 41 horizontal. However it is often the case that vehicle structure 20 beneath the floor 60 would prevent this unless the lift structure undesirably enters into the space 62 beneath the minimum angle of departure 63 which normally extends upwards and rearwards from the point of contact between the rear wheels 64 and ground 65. 25 Thus in the example of Fig. 1, brackets 70 are fixed to spaced fore-and-aft chassis members 71 of a monocoque body 72, and act as rear mounting for leaf springs 73.

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In the present lift, the rails 40, 41 can be mounted on the vehicle so as to be inclined upwards as they extend rearwards so that the inner ends C of the rails are below the springs 73 but the outer ends D are not 5 beneath the angle of departure but are still beneath the bumper.

The pivots 23, 24 and 23a, 24a are vertically spaced. The platform remains horizontal.

If desired the parallelogram can be modified so 10 that the separation between pivots 23, 24 may be slightly (e.g. 2mm) less than the separation between pivots 23a, 24a so that in the down position the platform inclines slightly downwards as it extends outwards and in the top position the platform is inclined slightly upwards as it 15 extends outwards. This is a safety feature. See also Fig. 13. The term parallelogram arrangement should be understood as including such an arrangement.

In the withdrawn position the platform can be raised between the rails to be parked between the 20 chassis members 71, subject to their spacing, and lightly held in contact with the body to resist rattle.

The lift can be mounted to extend sideways and as shown in Fig. 6 the rails may in some cases incline downwards enabling the lift to be mounted in cases where 25 the prop shaft 80 would effectively prevent horizontal mounting.

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Fig. 7 is generally similar to Figs. 2 and 3 but the motor 52 is central. Figs. 8 shows operation of a lift in association with a rear door of a vehicle. The platform may have a pivoted flap 76 to bridge any 5 gap between the platform and the floor 76a of the vehicle.

As shown in Fig. 9 the platform can be in two parts 110, 111 which are slidably cooperable. In this way the platform can be manually extended.

The arrangement of Figs. 10A, 10B is similar to 10 Figs. 2, 3 but, as shown, is intended for sale as a kit of parts and cross-members 81, 82 are fixed to rails 83, 84. The cross-members 81, 82 can be omitted if the rails are individually fitted to the vehicle. In this arrangement the rails 83, 84 have a vertical web 85, an 15 inwardly directed horizontal arm 86 at the top of web 85 and a downwardly and inwardly inclined web 87 at the bottom of web 85.

Spaced along the inner face of web 85 are spacers 88 to which is connected an elongate running rail 89 and 20 each side of the structure 11 is provided with rollers 90, 91, engaging the upper and lower edges of rail 89, and rollers 92, rotating about vertical axes, engaging the inner face 93 of exposed rail 89. This arrangement resists accumulation of dirt as might interfere with 25 proper operation, the dirt tending to wash or fall out of rails 83, 84. The structure 11 is moved in and out by motor 94 driving sprocket 95 engaging chain 96 which

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extends over sprockets 97 and is connected at its ends to cross members 81, 82 (see Fig. 11). As before the rails 83, 84 could be inclined.

Releasable means may hold the structure 11 in a  
5 forward and rearward position. These means could be  
remote controlled but as shown comprise latches 100  
engageable behind or in front of parts of structure 11  
and connected to rods 101 which can be rotated, against  
the bias of springs 102, by handle 103 to move the  
10 latches from the path of structure 11, a transverse  
rotatable rod 104 connecting the latch mechanisms at the  
two sides.

In another arrangement a manually releaseable sneck-type latch hook is mounted on the cross-members 81, 82  
15 cooperable with latches on the front and rear of structure 11.

The ram 34 is inclined downwards and pivots on bar 36 fixed to plates 30, 31 at a position spaced from and lower than axis 34a. The plates 30, 31 are fixed to cross  
20 member 29 fixed to upper parallelogram elements 21.

A feature of Fig. 10a, which can be used in the other embodiments in which the platform slightly changes its orientation as it is moved up and down is that the lower arms 22, 22A of the parallelogram can be slightly  
25 reduced in length compared with upper arms 21, 21A. This controls (Fig. 13) the position at which the platform is horizontal as it moves between an incline slightly downwards as it extends outwards when in the

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lowered position and an incline slightly upwards as it extends outwards in the raised position. The term parallelogram arrangement should be understood as including this modification.

5 In a modification Fig. 14 the sprockets 97 are positioned on top of structure 11 for rotation about vertical axes; this is for cases in which there is appropriate room beneath the vehicle, and provides an alternative drive means for the structure 11 which may 10 enable the overall height of the lift 10 to be reduced.

In an advantageous embodiment of Figs. 15, 16, 16A the platform has a pivoted part 112 which, in the raised and extended, or an intermediate and extended, position, can be folded inwards to form a step 113.

15 The extent to which the platform is raised by the ram can be adjusted by changing the position of pivot 36.

Fig. 17 shows a vehicle with rear door 113 and lift 10 having a platform 115 movable by, for example, a parallelogram lift device between lowered position on 20 the ground and a raised position providing entry to the door. The door could be on the vehicle side. The lift may be stowable, for example beneath the vehicle floor, by a rotary action or sliding action.

The platform has an inner part 76 which forms a 25 stop and a bridge plate and an outer part 114, which forms a wheel-chair stop and a ramp.

The part 114 automatically moves to a raised (wheel-chair stop) safety position when the platform is raised away from the ground,

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and automatically forms a ramp when the platform is in contact with the ground. The down ramp provides an upwardly inclined surface as it extends inwards.

At the outer end of the main platform 115 is a cross-member 130 having at each end a shoe 131 adapted to engage the ground and biased downwards by a spring 116. A pin 132 secured to link 133 has a lost motion connection in a slot 134 in an upstanding part 135 of the shoe. The link 133 is pivoted at 136 to a side wall 119 of the platform and has a pin 137 engageable with a tongue 138 on the part 114.

When the platform is being lowered, the part 114 is in the dotted position. The shoes 131 engage the ground and are moved upwards relative to the platform 115 against the action of the springs 116 and the links 133 are moved from the dotted to the full line position, taking the links over-centre and the part 114 moves to the full line position under gravity. Upward movement of link 133 is limited by engagement of member 130 in a recess 140 in the structure. The link arrangement provides a mechanical advantage.

The ramp part 114 moves under gravity and thus resists damage by engagement with a stone, and if accidentally engaging a user's foot for example will not damage the foot. On being raised from the ground, the springs 116 move over centre and move the shoes and links downwards and pivot the part 114 to the up, dotted, safety position. Downwards movement of the links is

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limited by engagement with stops 141. With ramp 114 up, this acts to resist movement of an article, e.g. a wheel-chair, off the platform away from the vehicle.

A pivoted hand rail 150 is provided.

5 Figs. 21, 22 show an arrangement in which bridge plate 76 is biassed down by spring 160. An arm 161 is connected at one end to element 21 and, as the lift is raised, disengages a roller 162 connected to a rod 163 secured to plate 76 so that the plate is rotated to 10 bridging position as the platform reaches the level of the vehicle floor. When the lift is lowered, the arm engages the link and moves the plate against the bias of the spring 160 to the upright position; this is a safety feature.

15 As shown in Fig. 15, the rails 89 can be modified so as to have a horizontal outer portion 89a connected by a curved portion 89b to a straight, stowage, portion 89c parallel to supports 83, 84. In this way the structure 11, and the platform, are stowed in an 20 inclined position but on being moved outwards adopt a horizontal position.

The lift may include electric control apparatus, including a hand-held switch box, and including limit switches for controlling the in and out movement of 25 structure 11 and the operation of the ram and the up and down movement of the parallelogram.

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CLAIMS

1. A vehicle lift comprising lift structure movable relative to a support between inner and outer positions, characterized by the lift structure comprising inner mounting structure and an outer platform, a parallelogram arrangement having an outer pivotal connection to the platform and an inner pivotal connection to the mounting structure, the inner pivotal connection comprising upper and lower pivots, and means for raising and lowering the parallelogram arrangement, the means being connected to the parallelogram spaced from the upper pivot.
2. A vehicle lift as claimed in Claim 1, comprising two laterally spaced parallelogram arrangements having coaxial upper pivots, the parallelogram arrangements being connected by intermediate structure pivoted to the mounting structure coaxial with the upper pivots, the means being pivoted to the intermediate structure.
3. A vehicle lift as claimed in Claim 1 or Claim 2, in which the means comprises a ram.
4. A vehicle lift as claimed in Claim 1, in which the support comprises spaced rails curved at an outer region so that the platform changes its orientation to the rails as the lift structure is moved between inner and outer positions.
5. A vehicle lift as claimed in Claim 1, in which the platform is adapted to form a step in the raised position.

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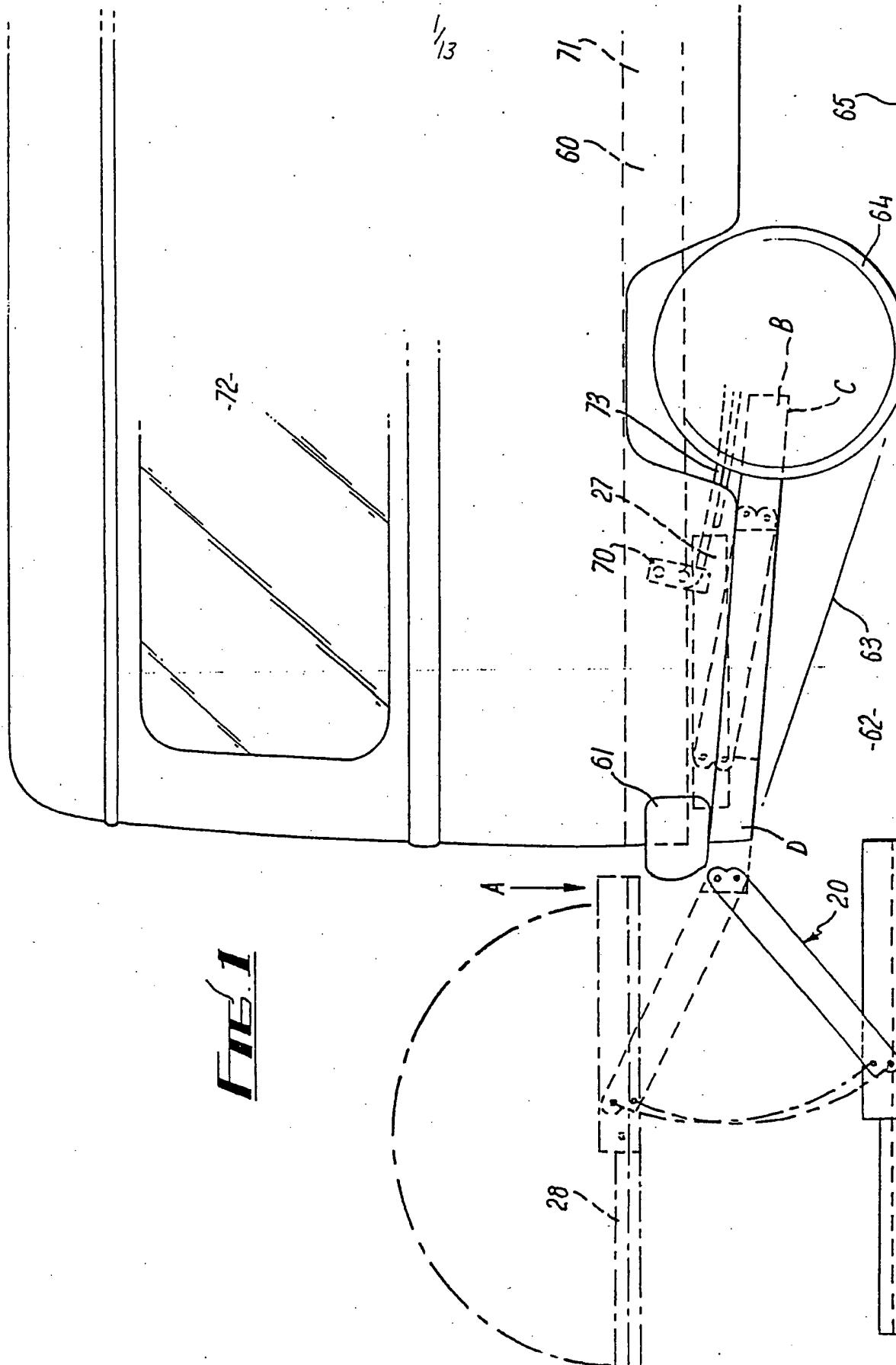
6. A vehicle lift as claimed in Claim 5, in which the step is formed by folding the platform.
7. A vehicle lift as claimed in any preceding claim, in which the parallelogram is modified to change the 5 inclination of the platform in the raised position.
8. A vehicle lift as claimed in Claim 7, in which the parallelogram is modified by shortening the inner of the shorter arms with respect to the outer.
9. A vehicle lift as claimed in Claim 8, in which the 10 lower of the longer arms is shortened with respect to the upper.
10. A vehicle lift as claimed in any preceding claim, in which the support comprises spaced rails, each rail comprising an exposed elongate element spaced from an 15 elongate member, and the mounting structure comprises rollers engageable with the element.
11. A vehicle lift as claimed in any preceding claim, in which the platform can be raised and lowered independent of the position of the lift structure relative to the 20 support.
12. A vehicle lift as claimed in any preceding claim, comprising a part movable between a normal upstanding safety position for resisting movement away from the vehicle of an article on the platform, and a lowered 25 position in which it forms a ramp, the movement being solely by engagement of the platform with the ground and through a link between the part and ground-engaging means.

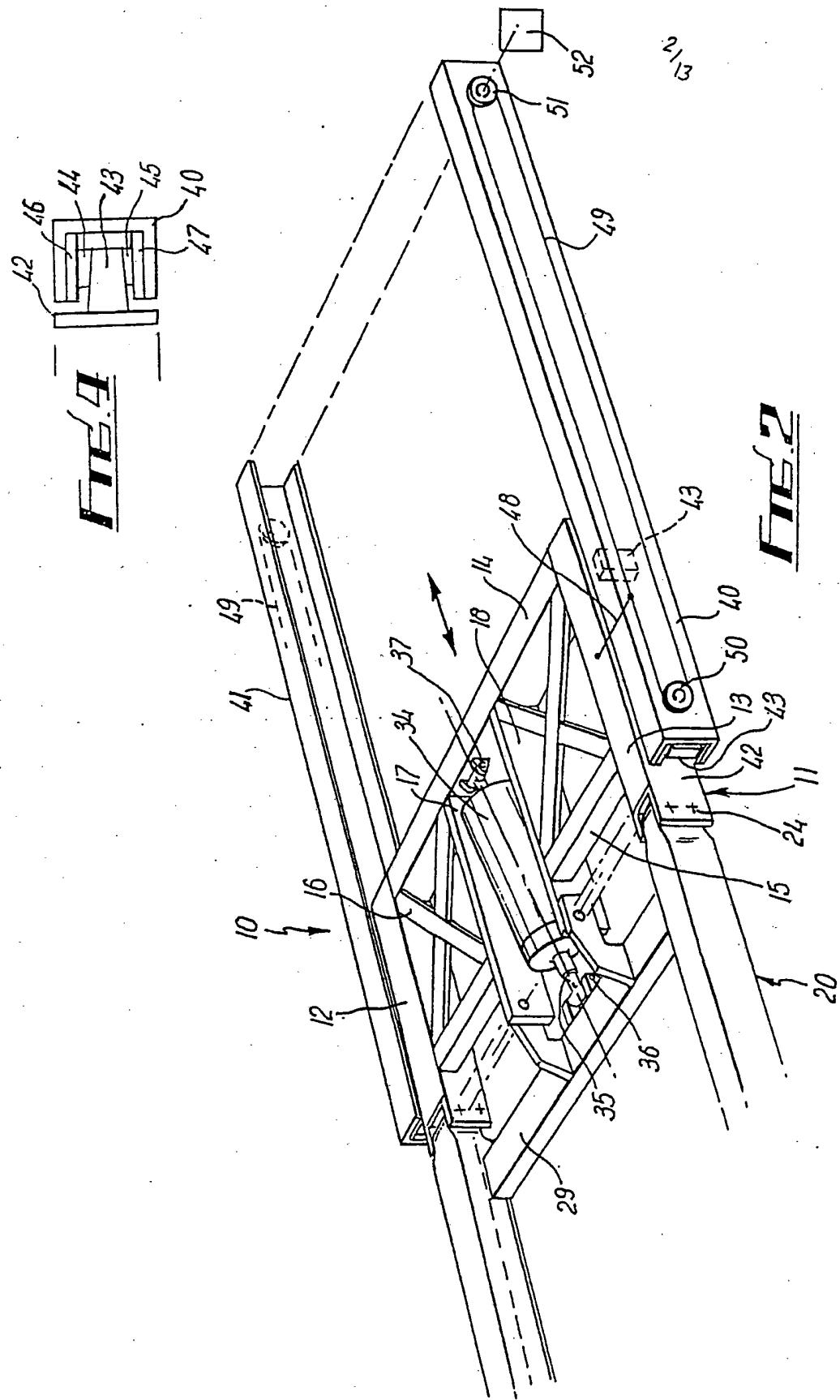
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13. A vehicle lift comprising a platform movable between extended and retracted positions, the platform in the extended position being movable between lower and raised positions, the platform being adapted to form a step in 5 a raised position.
14. A vehicle lift comprising a platform which can be raised and lowered by means comprising a parallelogram arrangement, in which the parallelogram is modified to change the inclination of the platform in a raised 10 position and a lowered position.
15. A vehicle lift including structure movable on rails, the rails comprising an exposed elongate element spaced from a support and engageable by rollers of the structure.
16. A vehicle lift comprising mounting structure movable 15 relative to a support between inner and outer positions, lifting structure comprising a platform and movable relative to the mounting structure between upper and lower positions independently of the position of the movable structure relative to the support between said 20 positions.
17. A vehicle including a vehicle lift as claimed in any preceding claim.
18. A vehicle as claimed in Claim 17, comprising a floor, in which the support is beneath the floor of the vehicle.

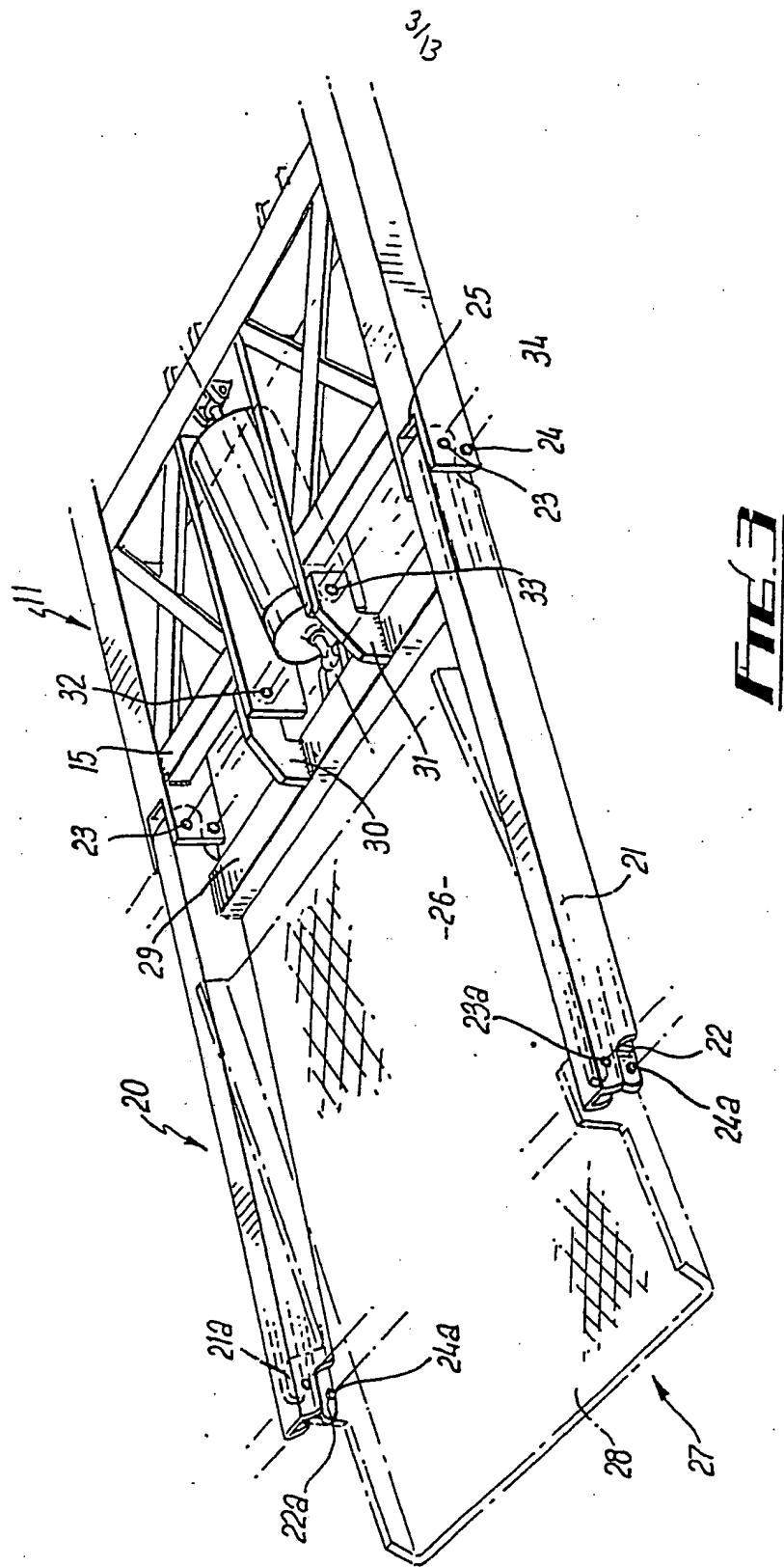
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19. A vehicle lift mounted beneath a floor of a vehicle and having support structure and lift structure movable relative to the support structure in a direction inclined to the horizontal between withdrawn and 5 extended positions, the lift structure including a platform movable up and down in the extended position.



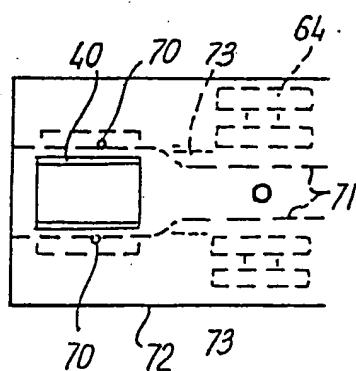
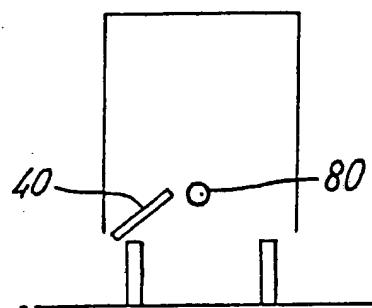


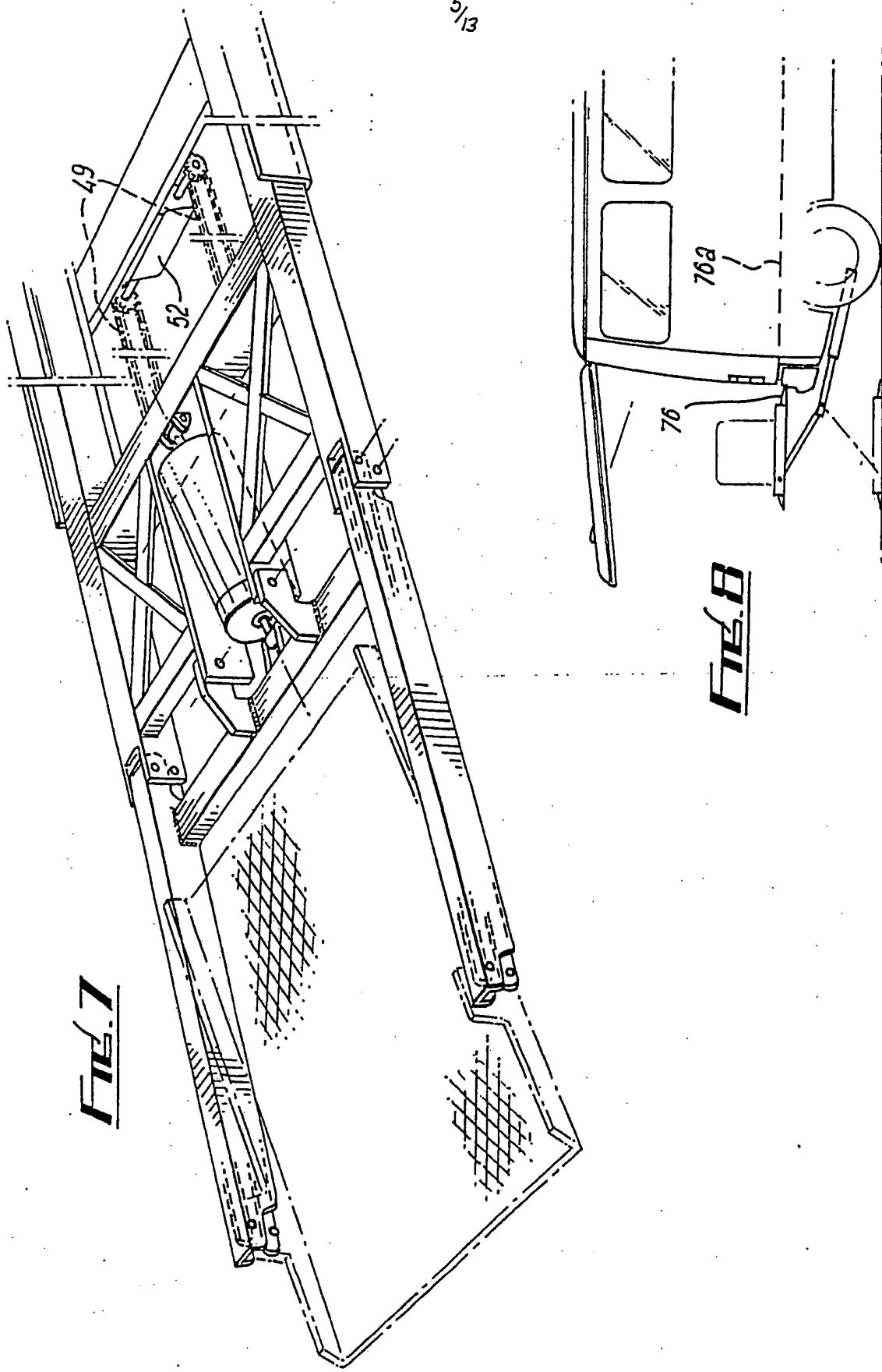
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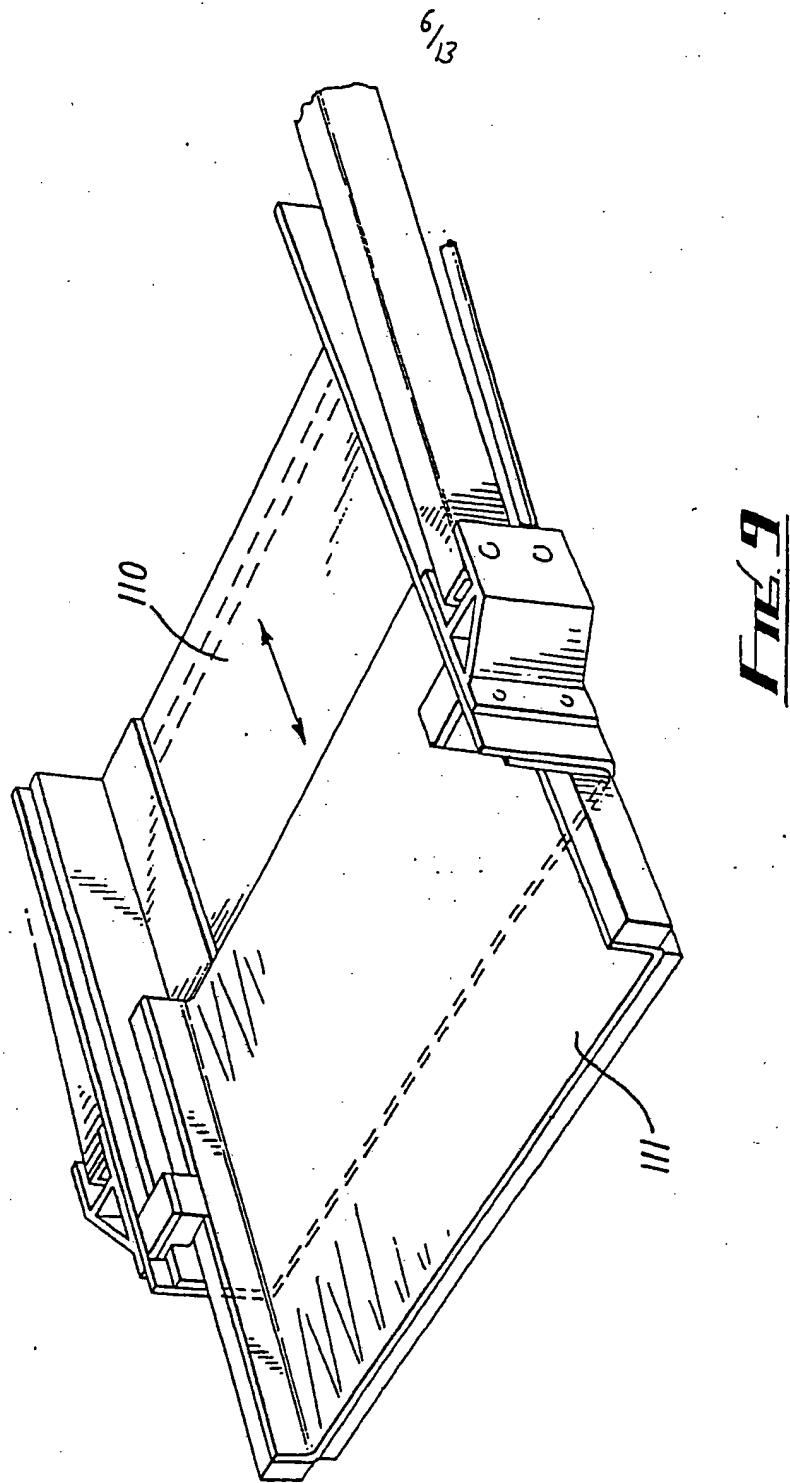
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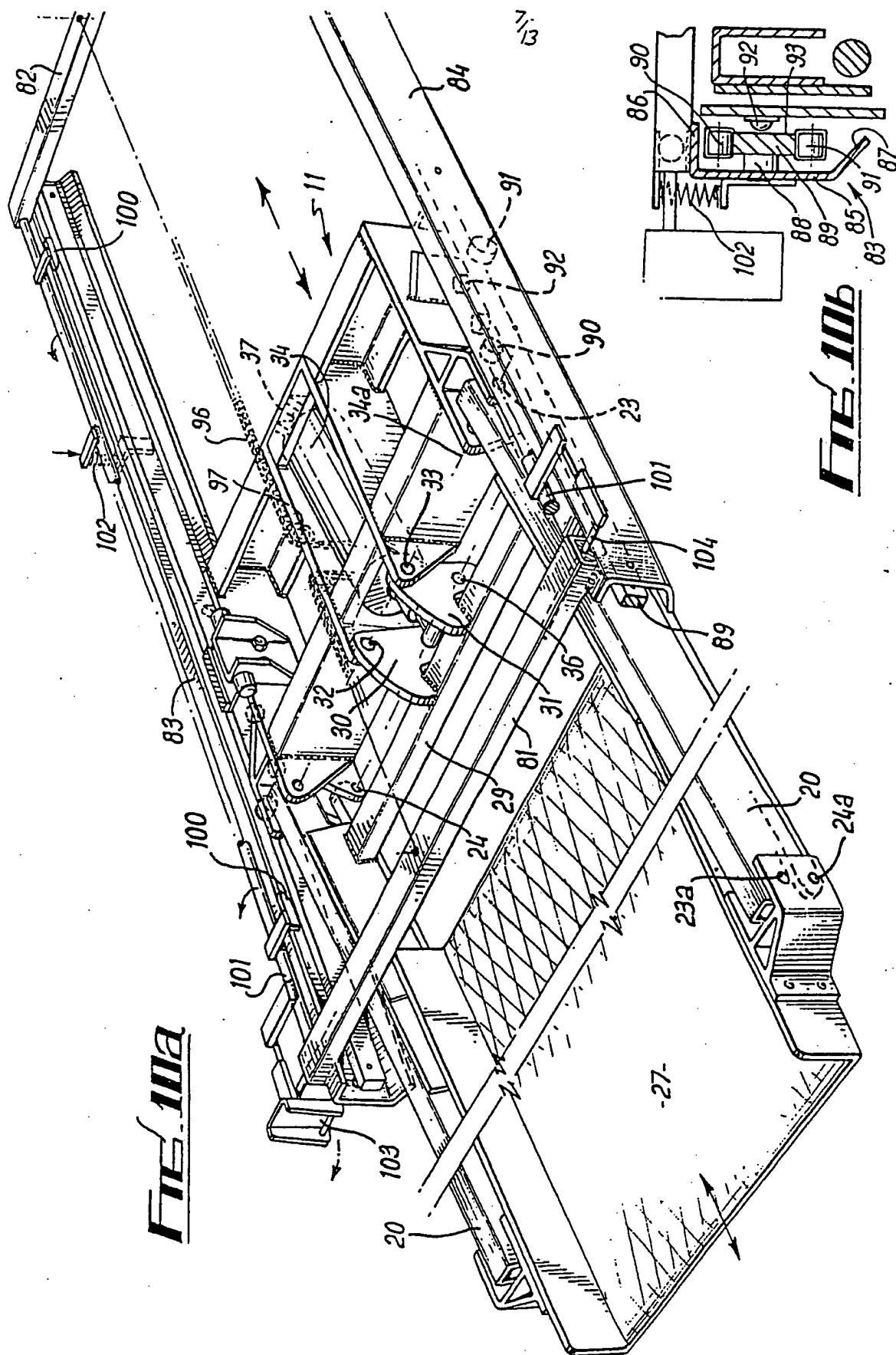
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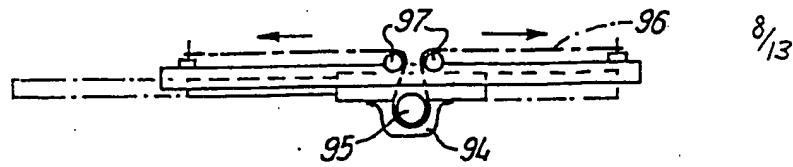
FIG.5FIG.6



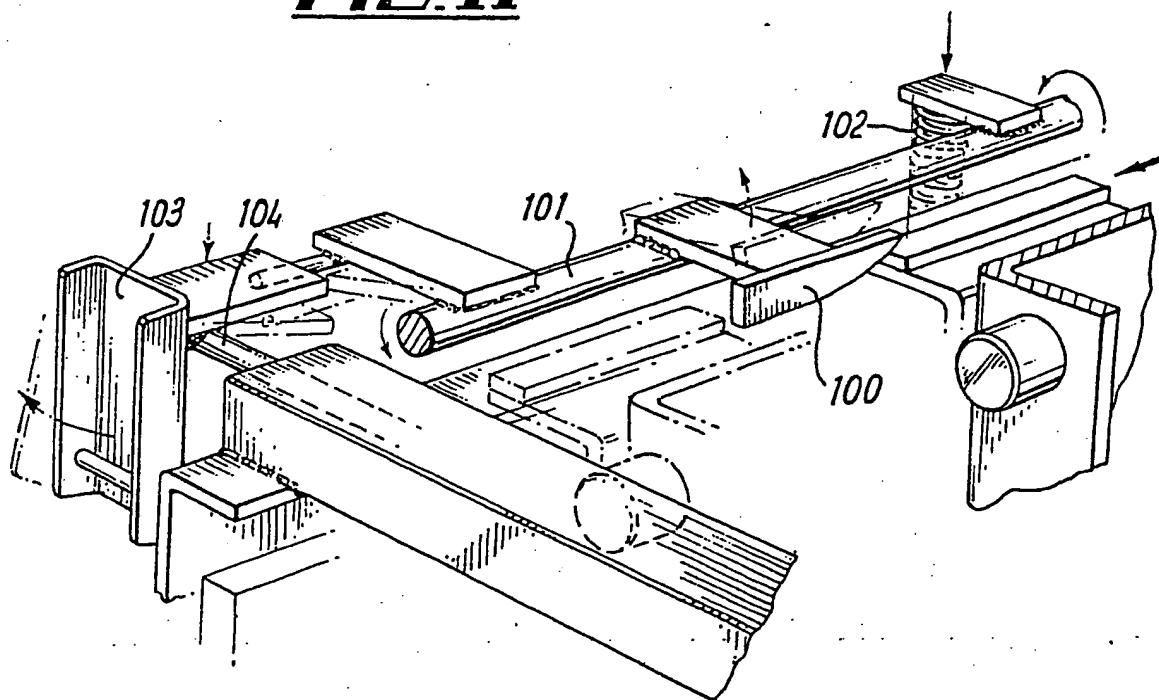
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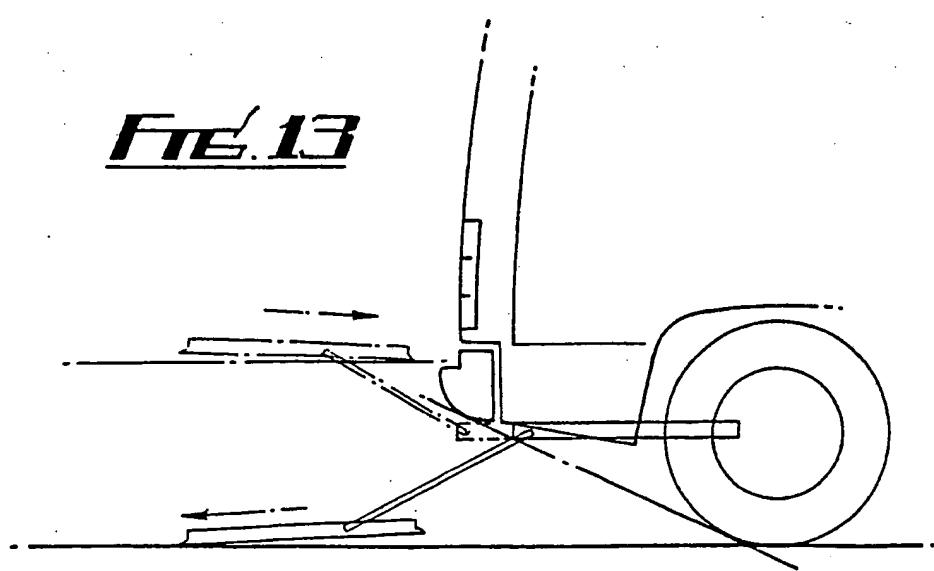


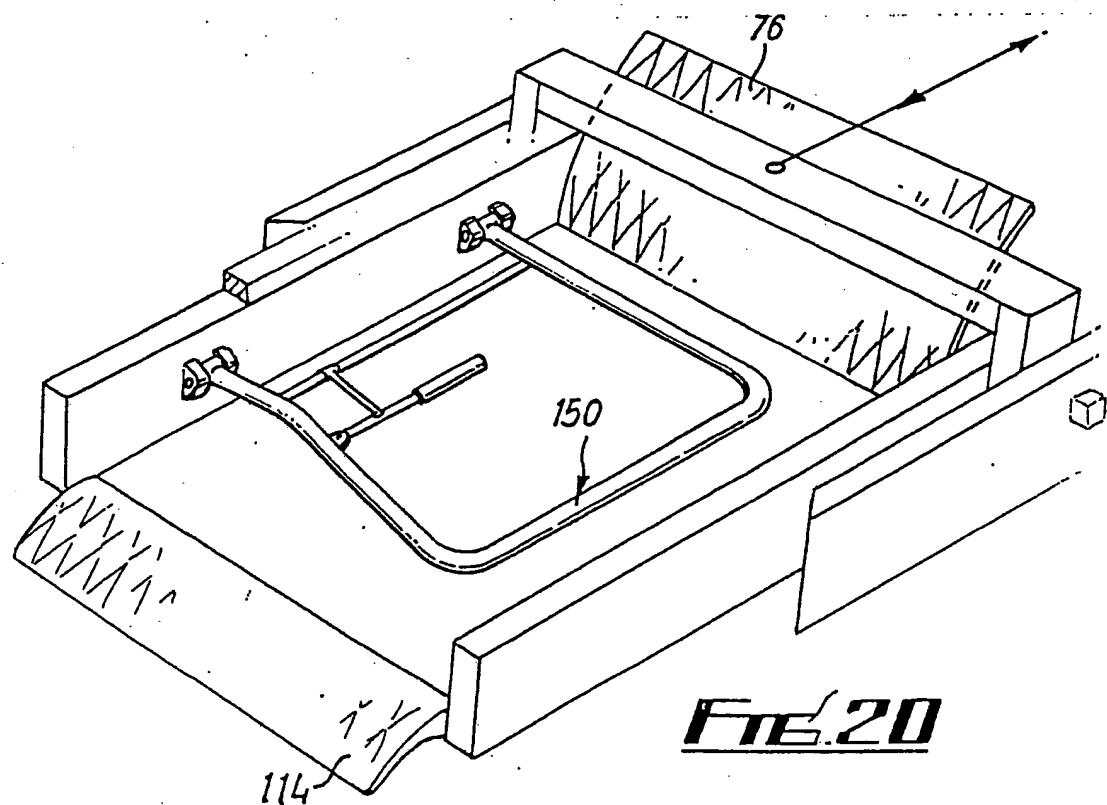
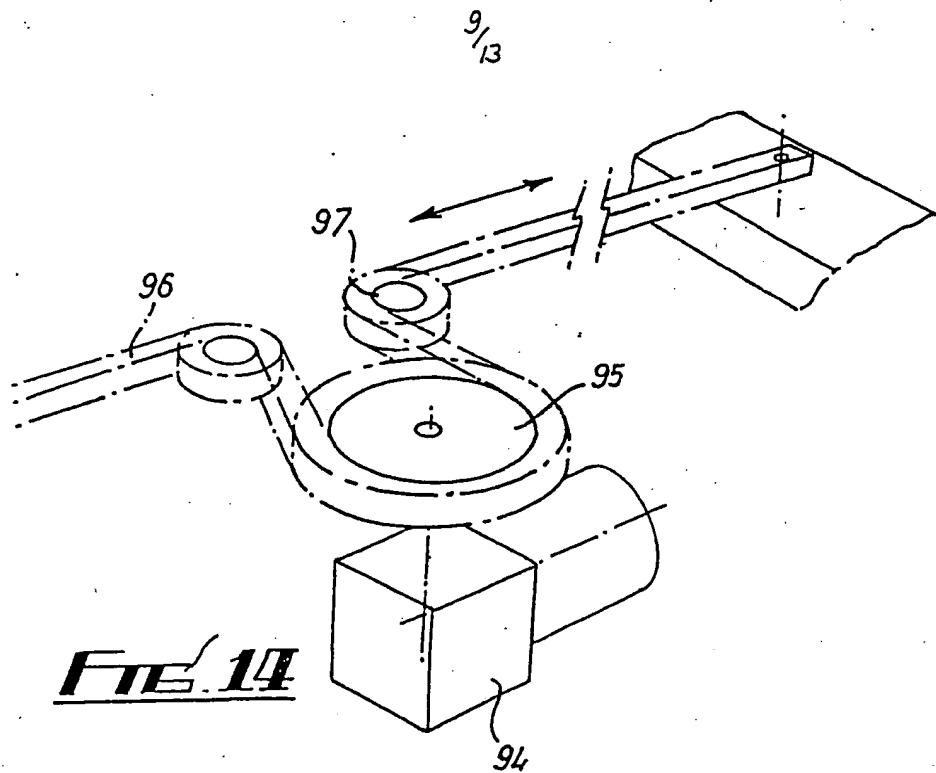
***FIG. 11***



***FIG. 12***

***FIG. 13***





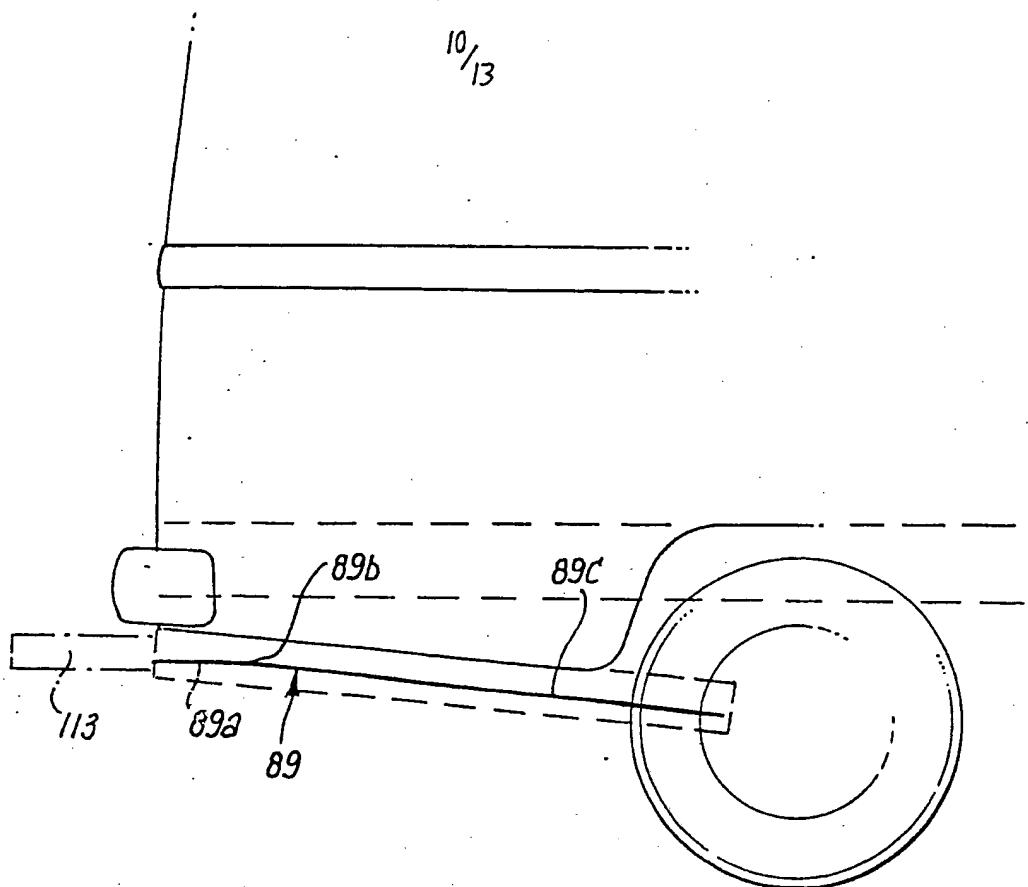


FIG. 15

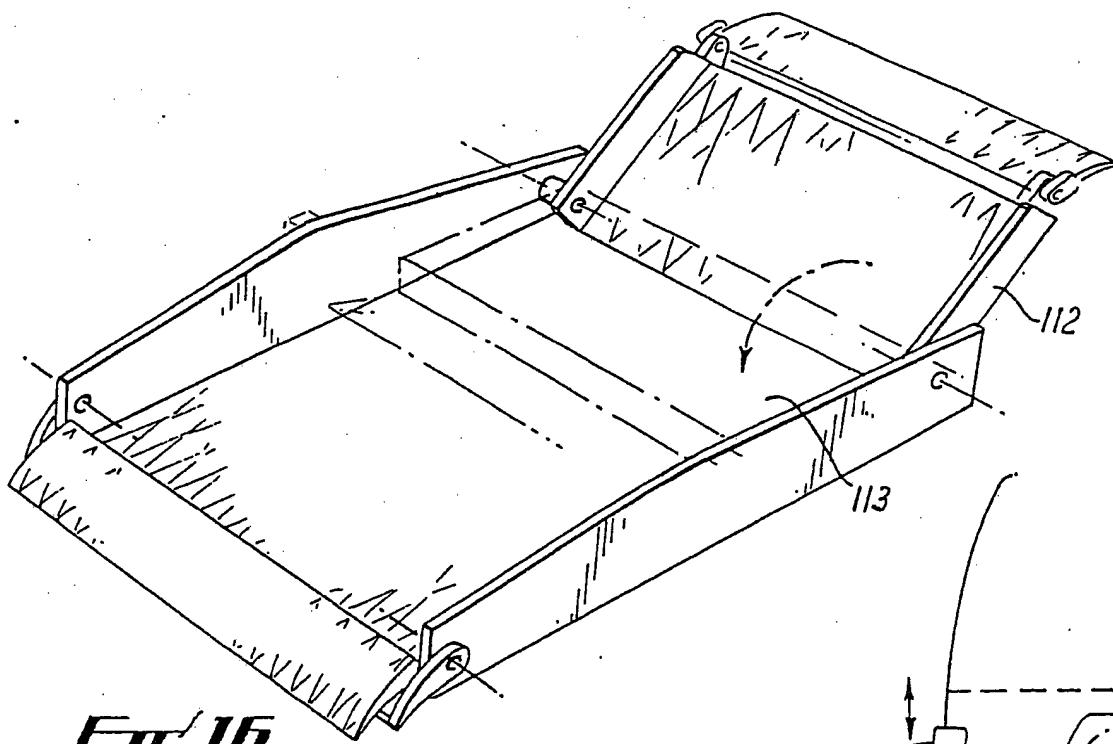
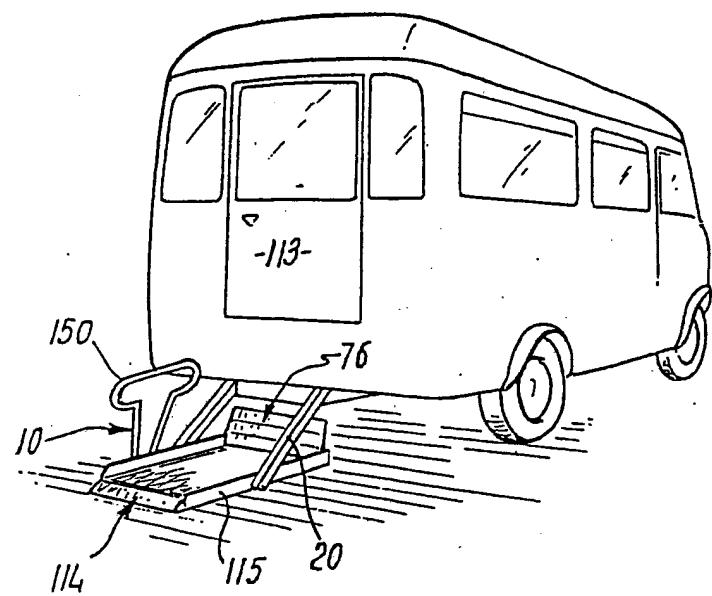


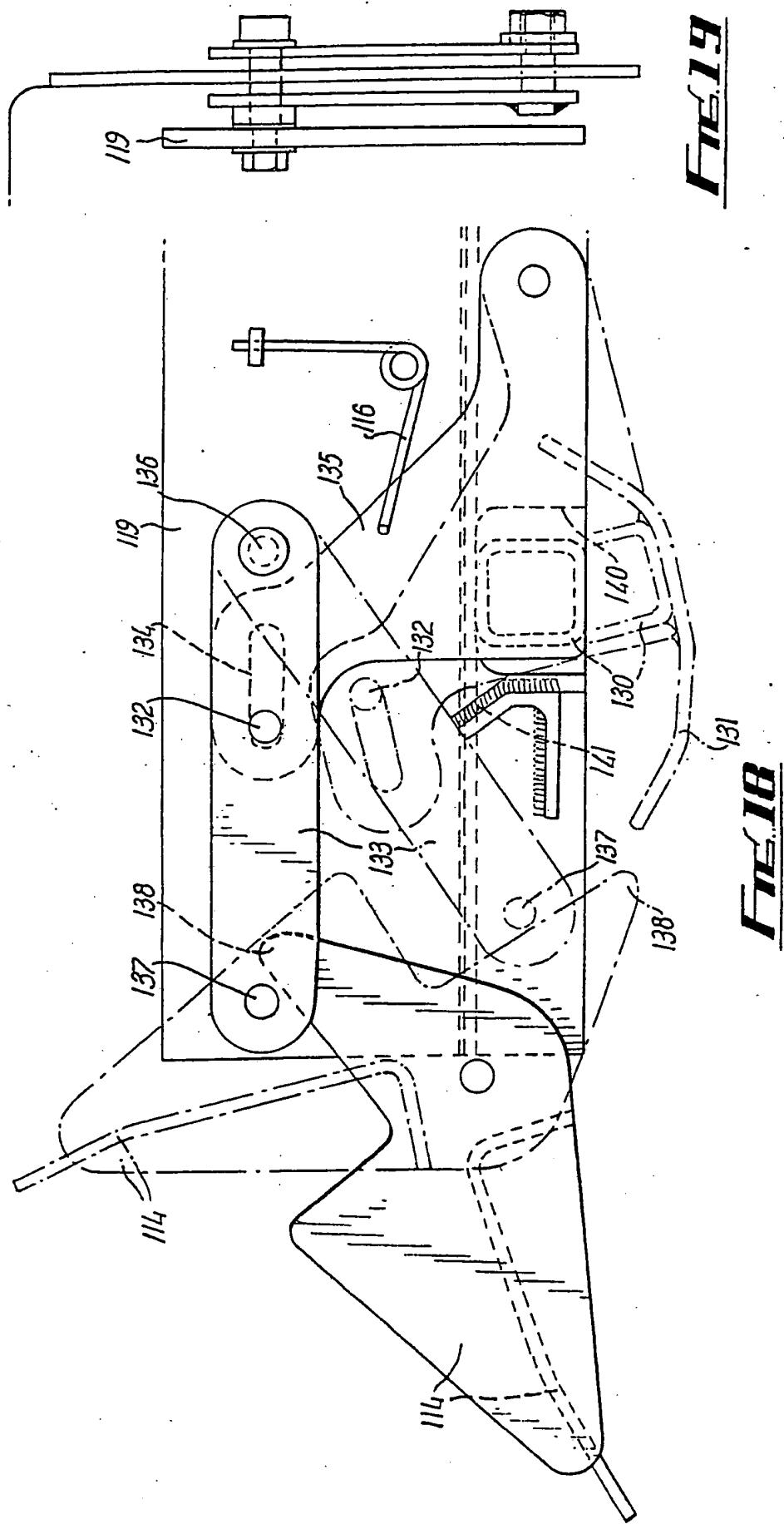
FIG. 16

FIG. 16A

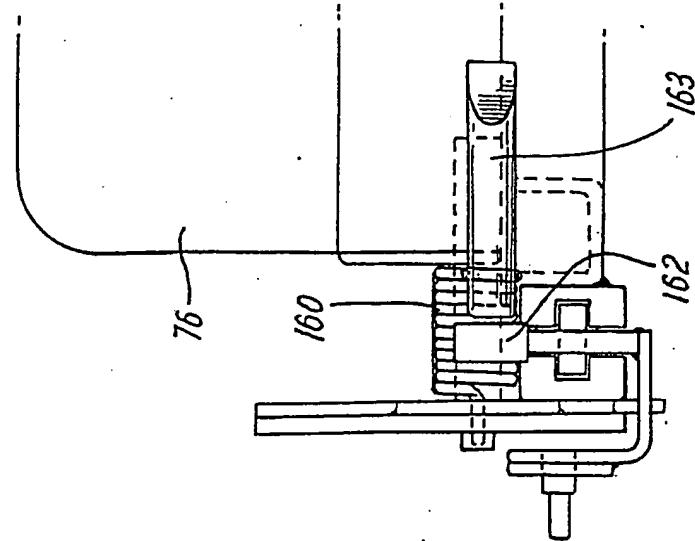
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FIG. 17

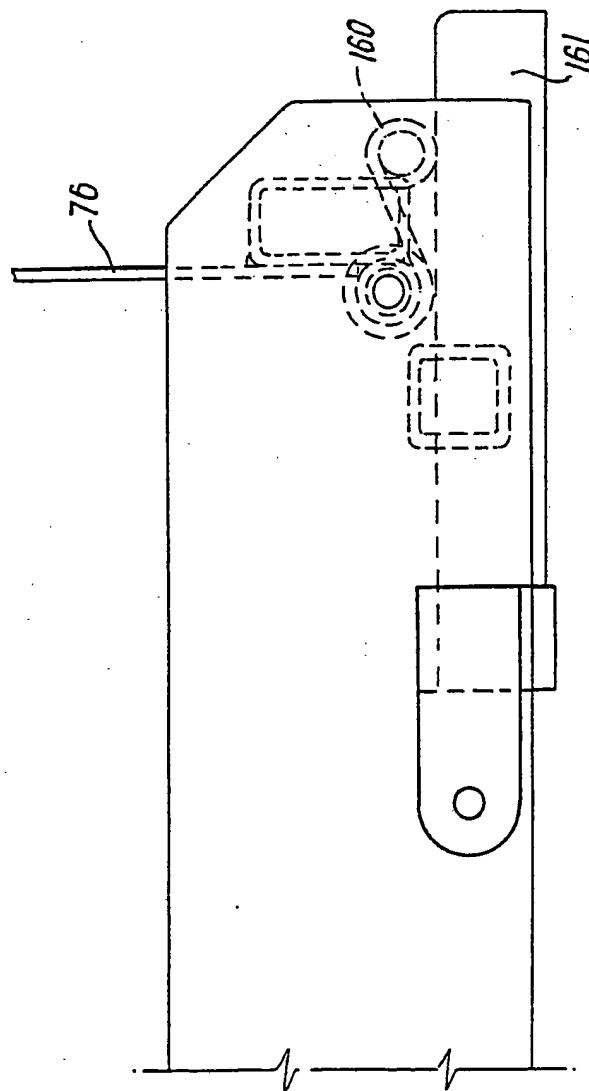
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FIGURE 22FIGURE 21

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 89/01316

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)<sup>6</sup>

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B60P1/44 ; A61G3/02

## II. FIELDS SEARCHED

Minimum Documentation Searched<sup>7</sup>

Classification System	Classification Symbols
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Documentation Searched other than Minimum Documentation  
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Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	EP,A,217467 (KLAUS HÖHNE METALLVERARBEITUNG) 08 August 1987 see column 2, line 25 - column 7, line 40; figures ----	1-3, 5, 6, 10, 11, 13, 15-18
X	US,A,4134504 (L. SALAS) 16 January 1979 see column 3, line 5 - column 6, line 58; figures ----	1-3, 10-12, 15-18
X	WO,A,8803484 (I. SVENSSON) 19 May 1988 see abstract; figures ----	1-3, 10-12, 15-18
X	US,A,4685860 (R. E. MCFARLAND) 11 August 1987 see column 8, line 3 - column 9, line 30; figures 11-17 ----	1, 2, 7, 9-11, 14-17 -/-

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- <sup>T</sup> later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- <sup>X</sup> document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- <sup>Y</sup> document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- <sup>&</sup> document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search

1

07 MARCH 1990

Date of Mailing of this International Search Report

27 MAR 1990

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

FRANKS B.G.



III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category >	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	DE,A,3531853 (H. DAUTEL) 12 March 1987 see column 4, line 37 - column 6, line 1; figure 1 ---	1, 3, 19

ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.

GB 8901316

SA 32309

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 07/03/90

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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US-A-4134504	16-01-79	None		
WO-A-8803484	19-05-88	AU-A- EP-A- SE-A-	8270987 0329697 8604797	01-06-88 30-08-89 11-05-88
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DE-A-3531853	12-03-87	None		